GLOSSARY

adaptive optics Optical components whose shape can be actively changed to compensate for optical wavefront distortions. NIF uses thin, electrically controlled, deformable mirrors for this function.

amplifier slab As used in NIF, a neodymium-doped phosphate glass slab that is set in the beam at Brewster's angle and pumped by xenon-filled flashlamps. The light from these flashlamps excites the neodymium ions to a higher energy state that leads to amplification of light beams at a small range of wavelengths around 1053 nm.

amplitude modulation Changing the amplitude of a signal without affecting its phase.

anode The positive electrode of an electronic device.

apodizer A variable-transmission filter that puts a smoothly varying irradiance profile on the edge of a beam in order to suppress diffractive ripples

architectural design The process of defining a collection of hardware and/or software components, their functions, interfaces, and key characteristics to establish a framework for system development.

architecture The logical and physical structure of a system forged by all the strategic and tactical decisions applied during development. Software architecture deals with abstraction, with decomposition and composition, with style and esthetics.

asynchronous transfer mode network (ATM) A cell-based switched network capable of carrying time-critical data such as video.

backlighter/backlighting Many NIF experiments will require that some of the beams be used to generate a source of x rays that is used to photograph the main experiment. This source is usually called a "backlighter."

beam dump An optical component that disposes of an unwanted beam safely.

birefringence A material has this property if its index of refraction differs for different light polarizations. An input light beam is then separated into two beams that take slightly different paths through the material.

blast shield As used in NIF, a glass shield that protects amplifier slabs from contamination generated by flashlamps.

borosilicate float glass A high-quality window glass manufactured by floating molten glass on a liquid metal support.

boule An "as-grown" synthetic crystal before finishing.

Brewster's angle A beam of light incident on a slab of optical glass at this angle (about 57^{o} to the surface normal) has zero reflection for one of the polarization components of the beam.

Brillouin scattering Stimulated Brillouin scattering (SBS) is an interaction between light and sound waves in a material that leads to the growth of the sound wave and a second, scattered light wave. It is an undesirable effect in large lasers.

bundle A NIF "bundle" is an array of beams stacked four high and two across. The bundle is the basic building block of the laser system.

calorimeter A device used for measuring the energy of a laser pulse by measuring the temperature rise of an absorber.

canister A protective cover "box" in which a line-replaceable unit (LRU) is placed for transport to a desired location.

cathode The negative electrode of an electronic device.

cavity spatial filter (CSF) The spatial filter within the NIF main laser multipass cavity.

centering Positioning a beam in the center of an optical aperture when the beam is at full size (near field). See pointing.

charge-coupled device (CCD) A type of image sensor used in TV cameras.

class In software parlance, a class is a set of objects that share a common structure and a common behavior. Typically classes are static; their existence, semantics, and relationships are fixed prior to the execution of a program.

clear aperture That portion of the aperture of an optical component that we allow the laser beam to occupy. See hard aperture.

client An object acts as a client in an interaction with another object (the server) if it initiates the interaction.

client/server computing Client/server computing encompasses a decentralized architecture that enables end users to gain access to information transparently within a multivendor environment of heterogeneous hardware and software platforms.

cluster A NIF "cluster" is an assembly of six bundles. The NIF laser contains four clusters, each containing 48 beams.

color separation grating (CSG) As used on NIF, a kinoform that transmits 3ω with no deflection, but diffracts 1ω and 2ω away from the target.

common object request broker architecture (CORBA) An *ad hoc* industry standard for software objects that communicate across processors in a network.

configuration A framework that is a collection of classes that all subsystems use to maintain the complete as-built description of the devices that they control.

dark-field imaging See schlieren technique.

datum A precise position reference.

diffractive optic See kinoform.

doubler A frequency conversion crystal that converts 1ω to 2ω.

event-based A system organizing concept (from the software programmer's point of view) wherein an application program is notified of outside occurrences by events.

far field A position in an optical train that is very far from an image. In NIF, the far fields occur at the focal planes of lenses in the spatial filters or the target chamber.

Faraday rotator An optical device that uses Faraday's magneto-optic effect to rotate the plane of polarization of a light beam.

filamentation See nonlinear index.

final optics assembly (FOA) A NIF assembly that includes the target chamber vacuum window, final optics cell, diffractive optics plate, debris shield, and some laser diagnostics.

final optics cell (FOC) The final optics cell is an assembly that holds and positions the two frequency conversion crystals and the target focus lens.

first wall The inside wall of the NIF target chamber. It must be highly resistant to x rays, other target radiation and debris, and laser light.

flashlamp As used in NIF, a xenon-filled quartz gas-discharge lamp that is used to pump amplifier slabs.

fluence The energy per unit area (generally J/cm^2) in a beam of light.

framework A large-scale software building block. A framework provides architectural guidance by partitioning the design into abstract classes and defining their responsibilities and collaborations.

freeboard The difference between the maximum expected aperture occupied by a beam and the actual clear aperture of an optical component.

Fresnel lens A thin lens constructed with stepped setbacks so as to have the optical properties of a much thicker lens; also an example of a "kinoform."

front-end processor (FEP) The low-level computer that implements device control.

fused silica A glassy, noncrystalline form of quartz (SiO_2). The fused silica used in NIF is usually a high-purity form that is manufactured by chemical vapor deposition (CVD).

Gaussian beam The beam generated by a laser that is forced to operate in a single, lowest-order mode.

ghost beam, ghost focus, ghost reflection Optical components that transmit laser beams in NIF are antireflection coated, but these coatings are never perfect so some very small laser energy is reflected at each of these surfaces. Although the energy in these beams is small, it is important to manage carefully where it goes in the system. If these beams come to a focus, for example, they can easily reach fluences that cause severe damage to components located near that focus.

half-wave plate A thin section of a birefringent crystal cut so that it rotates the polarization of light passing through it when the crystal is rotated around its optical axis.

hard aperture The aperture set by the mechanical mounting hardware for an optical component. The beam must not strike this hardware, consequently the hard aperture is larger than the clear aperture.

Hartmann sensor, Hartmann wavefront sensor A sensor that uses an array of small lenses to measure local wavefront tilts on a beam. The lenses generate an array of far-field spots on a charge-coupled device (CCD) camera, and image-processing software uses the positions of these spots to reconstruct the wavefront of the beam.

HEPA High-efficiency particulate air. A type of air filter using paper elements that is commonly used in clean rooms.

hierarchy A ranking or ordering of abstractions where the lowest common denominator is placed at the top and from this base all other classifications arise.

image relay An arrangement of optical components that forms a real image of a beam-defining aperture at several points ("relay image planes") through an optical system. Effective optical propagation distances are reset to zero at each image, so an image-relayed system has less beam modulation from diffraction than an unrelayed system.

injection system A NIF system that takes the input beam from the preamplifier beam transport system (PABTS) to the pinhole plane of the transport spatial filter.

input sensor A NIF system that diagnoses the output of the preamplifier module (PAM) before it is injected into the main laser cavity.

Integrated Computer Control System (ICCS) The system of computers and software which control NIF and stores information about its history and operation.

integrated optics module (IOM) An assembly that holds and positions the target chamber vacuum window, final optics cell (FOC), diffractive optics plate, and debris shield for a single beam of NIF. The IOM is a line-replaceable unit. (See final optics assembly.)

irradiance The power per unit area (generally W/cm^2) in a beam of light. Sometimes called "intensity;" however, the official SI definition of intensity includes a measure of the divergence of the beam.

KDP, KD*P Potassium dihydrogen phosphate crystal (KH_2PO_4). Thin plates of this crystal and its deuterated analog KD*P (KD_2PO_4) are used as the active optical elements in the NIF PEPC and frequency converter.

kinematic mount A mount designed so that components placed on it are forced to come to rest in a very precise location.

kinoform An optical component with fine phase structure that changes the phase of a beam ("diffractive optic").

laser entrance hole (LEH) An aperture in a hohlraum target through which the laser beam enters the hohlraum.

line-replaceable unit (LRU) A self-contained package, containing multiple laser components, that can be assembled and tested off-line in a clean room and then installed on the laser as a unit while preserving its highly clean and prealigned state. LRUs are installed on prealigned kinematic mounts in the NIF laser. Examples include the preamplifier module (PAM), a column of four amplifier slabs in the amplifier; a cassette of flashlamps in the amplifier; a column of four spatial filter lenses; and an integrated optics module (IOM) in the final optics assembly.

machine history Data that are saved by the integrated computer control system (ICCS) software that are pertinent to the operation and maintenance of NIF.

message log A framework that stores and retrieves text messages from many software components for the purpose of constructing an audit trail of system action.

near field A position in an optical train that is close to an image. In NIF, these are the regions where the beam is at its full size.

nonlinear index, nonlinear phase shift Optical materials have an index of refraction, which is the ratio of the speed of light in a vacuum to the speed in the optical material. At very high irradiance the index of refraction increases, or the speed of light is reduced in the material. Local regions of high irradiance travel more slowly, so the optical wavefront becomes concave near them. A concave wavefront is a focusing wavefront, so the local irradiance grows even larger as the diameter of the local hot spot decreases. This process amplifies any irradiance noise on the laser beam and can ultimately lead to "filamentation." In filamentation, the local region of high intensity collapses to an extremely intense spike that damages the material along a track a few microns in diameter. A few micron-sized damage tracks of this sort cause no particular harm, but a large density of them can obscure parts of the beam and can initiate further optical damage.

object A software entity that the system can act upon.

optical damage High laser irradiance and fluence can heat small defects in the bulk or on the surface of an optical component. These defects then explode and can cause damage (such as a pattern of small fractures) to the component. These damage sites may grow to a size that affects the laser's operation on subsequent shots, and the component must then be replaced. Components for a high-fluence laser such as the NIF must have a low density of defects and must also be kept very clean so that dirt particles that might initiate damage are very infrequent.

optical pulse generation system (OPG) The low-energy, small-aperture parts of the NIF laser that shape and amplify the laser pulses before they are injected into the main laser cavity.

output sensor A NIF assembly that diagnoses the output beam from the laser.

periscope As used in the NIF, the structure that supports the plasma-electrode Pockels cell (PEPC), polarizer, and two laser mirrors—LM2 and LM3.

periscope installation assembly A type of line-replaceable unit (LRU) installation structure that requires the use of spacers to lift LRUs to the required heights for installation.

phase modulation Changing the phase (or frequency) of a signal while the amplitude is held constant.

pinhole As used in NIF, an aperture in the focal plane of a spatial filter. The main laser pulse goes through the aperture, while stray light and high-spatial-frequency noise hit the edge of the aperture and are removed from the beam.

plasma-electrode Pockels cell (PEPC) A Pockels cell that uses tenuous helium plasmas as electrodes to apply a voltage to the active element.

plenum A chamber used to connect a gas supply or a vacuum pump to other volumes that require these services.

Pockels cell An electro-optic switch that rotates the polarization of a light beam passing through a material when an electric field is applied to the material in the direction of beam travel (Pockels effect).

pointing Positioning a beam to the correct angle as it passes through an optical component at full size (near field). Pointing can also be described as centering a beam focal spot on the pinhole in a spatial filter pinhole plane (far field). See centering.

polarizer An optical element that separates the two polarization states of a light beam. The polarizers used on NIF are thin-film polarizers consisting of a specially designed multilayer coating applied to an optical glass substrate.

preamplifier beam transport system (PABTS) An optical system that transports the beam from the preamplifier module to the injection system in the transport spatial filter.

preamplifier module (PAM) A NIF component that is a self-contained package (LRU) that amplifies a shaped input pulse from an optical fiber to a level of about 10 J. The output from the PAM is split four ways into the four beams of a 2 × 2 quad.

pupil relay system See relay imaging.

pyrolitic graphite A highly pure form of graphite manufactured by chemical vapor deposition.

quad A "quad" is a 2 × 2 array of NIF beams. It is the basic building block of both the PAM and the beam transport system from the laser to the target chamber. Each bundle contains two quads, one routed to the top of the target chamber and the other to the bottom.

Raman scattering Stimulated Raman scattering (SRS) is an interaction between light waves and molecular vibrations or rotations in a material that leads to the growth of the molecular vibration or rotation and a second, scattered light wave. It is an undesirable effect in large lasers.

regen See regenerative amplifier.

regenerative amplifier A multipass amplifier having a large number of passes. As used in NIF, an amplifier stage in the preamplifier module.

relay imaging, relay plane See image relay.

relay telescope See spatial filter and image relay.

reservation A framework that assures orderly access to shared equipment.

reticle A pattern inserted into an optical path to aid in measuring angles or positions.

rod amplifier An amplifier whose active element is in the shape of a glass rod (cylinder). See amplifier slab.

Roots blower A type of high-volume vacuum pump.

schlieren technique A technique for emphasizing light scattered from small structures on an optical component. The main beam is blocked at a focal plane, and the only light remaining is the high-spatial-frequency noise on the beam that lies outside the main focal spot. This is the inverse of the usual pinhole spatial filtering.

sequence control language (SCL) A framework that implements a sequencing language used to execute user-defined and SCL-defined commands within a subsystem. Each subsystem determines which of its commands may be executed by SCL sequences.

serrated aperture A type of apodizer. See apodizer.

server An object is a server in an interaction with another object (the client) if it is the passive object which is invoked by a subprogram call.

smoothing by spectral dispersion (SSD) A technique for beam smoothing in which a diffraction grating disperses a broad-band beam through a slight angle. This causes motion of the small-scale speckle structure in the spot on the target and tends to average over intensity nonuniformities in the spot.

software tool A computer program used to help develop, test, analyze, or maintain another computer program or its documentation; for example, automated design tool, compiler, test tools, maintenance tool.

solgel As used here, a technique for applying antireflection coatings to optical elements. The coating is composed of ~50-nm particles of silica (SiO_2) deposited from an alcohol solution.

spatial filter An arrangement of two lenses, separated by the sum of their focal lengths, with an aperture at the common focus to restrict the range of angles in a beam of light.

speckle Random irradiance fluctuations in a beam caused by interference of randomly phased small areas.

status monitor A framework that defines strategy to acquire status information from various NIF components.

streak camera An instrument for measuring very fast events. A slit allows a one-dimensional strip of a light beam to strike a photosensitive cathode. Electrons emitted by the cathode are manipulated to form a two-dimensional image in which one dimension is the strip and the other dimension is time.

taxon the name applied to a taxonomic group in a formal system of nomenclature. In NIF, the taxonomic name of a NIF device classifies it according to its location within the hierarchy of the laser assembly.

Title I, II, III Project stages as defined by the Department of Energy in DOE Order 4700.1 or the DOE Glossary. In brief, the completion of Title I means that the project design is completed to a level of detail that allows a reliable cost estimate, and the completion of Title II means that drawings and procurement packages are completed to a stage that they can be sent for procurement of the buildings and components. Title III activities are project activities that follow procurement and occur before the facility is turned over to operations personnel. These include acceptance tests, installation, and any engineering modifications that are required.

transporter A forklift-type device for moving LRUs to different locations.

transport spatial filter (TSF) In NIF, the 60-m-long spatial filter that lies between the laser and the target area.

trigger pulse A signal that commands an instrument to start.

tripler A frequency conversion crystal that sums 1ω and 2ω beams to give 3ω.

trombone An optical path of adjustable length used to equalize the propagation distance of two or more beams.

turbomolecular drag pump A type of high-vacuum pump.

vacuum manifold See plenum.

VME bus Versa Module Eurocard bus—an industry standard bus for embedded systems.

wavefront error The phase error on an optical beam caused by the accumulation of small errors in optical components (fabrication uncertainty, inhomogeneous material, mounting distortions, etc.)

1ω The fundamental frequency of a neodymium glass laser, corresponding to an infrared wavelength of 1053 nm (commonly called “red”).

2ω The second harmonic of a neodymium glass laser, corresponding to a visible wavelength of 527 nm (“green”).

3ω The third harmonic of a neodymium glass laser, corresponding to an ultraviolet wavelength of 351 nm (commonly called “blue”).

ACRONYMS

ACS	access control system
AGV	automated self-guided vehicle
AMPLAB	Amplifier Module Prototype Laboratory
ATM	asynchronous transfer mode network
BK7™	a standard borosilicate optical glass (Borosilikat Kron 7)
BLDS	bottom loading delivery system
CEA	*Commissariat a l'Energie Atomique* (French Atomic Energy Commission)
CCD	charge-coupled device
CCI	Cleveland Crystals, Inc.
CCRS	chamber-center reference system
CD	conceptual design
CDR	conceptual design report or review
CORBA	common object request broker architecture
CPU	central processing unit
CSF	cavity spatial filter
CSG	color separation grating
CS&T	core science and technology (LLNL laser research not part of the NIF project)
CVD	chemical vapor deposition
CW *or* **cw**	continuous wave
DAS	data acquisition system
DIM	diagnostic instrument manipulator
DOF	degrees of freedom
EMI	electromagnetic interference
EMP	electromagnetic pulse
FAU	frame assembly unit
FEM	facility environmental monitor
FEP	front-end processor
FF	far field
FOA	final optics assembly
FOC	final optics cell
FOV	field of view
FXI	framing x-ray imager
GFRC	graphite fiber-reinforced carbon
GUI	graphical user interface
GXI	gated x-ray imager
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air conditioning
IBE	interstage beam enclosure
ICCS	integrated computer control system
ICF	inertial confinement fusion
ICS	industrial controls system
IDL	interface definition language
IOM	integrated optics module
ISS	integrated safety system
ITS	integrated timing system
KDP	KH_2PO_4 crystal (potassium dihydrogen phosphate)
KD*P	KD_2PO_4 crystal (potassium dideuterium phosphate)
KPP	kinoform phase plate
LANL	Los Alamos National Laboratory
LEH	laser entrance hole
LLE	Laboratory for Laser Energetics, University of Rochester, NY
LLNL	Lawrence Livermore National Laboratory
LM	laser mirror
LMJ	*Laser Megajoule* (laser project in France comparable to the NIF)
LM1	laser mirror 1 (a deformable mirror)
LRU	line-replaceable unit
LTAB	Laser and Target Area Building
MA	Main amplifier
MOR	master oscillator room
MTV	maintenance transport vehicle
NF	near field
NIF	National Ignition Facility
NS	neutron spectrometer
OAB	Optics Assembly Building
OPG	optical pulse generator
P–V	peak-to-valley
PA	power amplifier

PABTS	preamplifier beam transport system
PAM	preamplifier module
PAMMA	preamplifier module maintenance area
PASS	preamplifier module support structure
PEPC	plasma-electrode Pockels cell
PLC	programmable logic controller
RP0	relay plane zero
SBS	stimulated Brillouin scattering
SCL	sequence control language
SF	spatial filter
SIS	safety interlock system
SL	side loading
SNL	Sandia National Laboratories
SQL	structured query language
SRS	stimulated Raman scattering
SSD	smoothing by spectral dispersion
SXI	static x-ray imager
SY/TA	switchyard and target area
T&H	transport and handling
TCP/IP	standard internet communication protocol
TL	top loading
TRXI	time-resolved x-ray imaging system
TSF	transport spatial filter
TWTT	two-way time-transfer technique
VME	Versa Module Eurocard (bus)
XSSC	x-ray streaked slit camera